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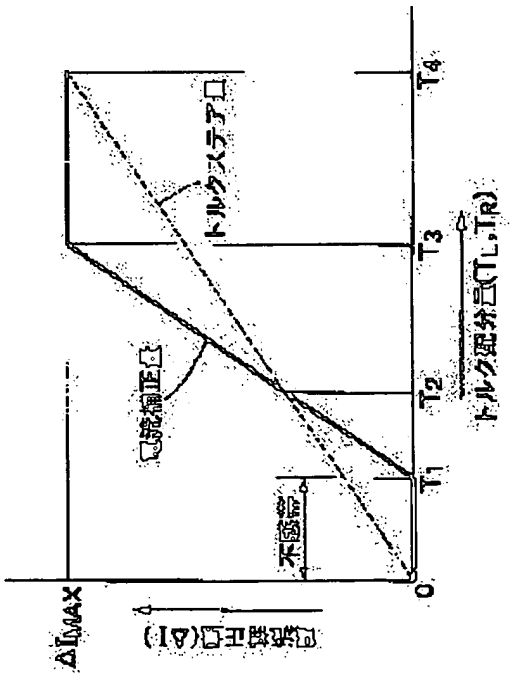
(54) COOPERATIVE CONTROL DEVICE FOR VEHICLE

(57)Abstract:

PROBLEM TO BE SOLVED: To prevent a driver from receiving unfamiliar feeling caused by generation of large auxiliary steering torque in a region of a small driving force/ braking force distribution amount, in a cooperative control device for a vehicle for cooperatively controlling a driving force/braking force distributor and an electric power steering gear to reduce a torque steering phenomenon.

SOLUTION: Although a torque steering amount generated in response to actuation of a driving force distributor is proportional to a torque distribution amount, a current correcting amount ΔI for controlling an electric power steering gear to nagate the torque steering amount is set in zero in an unsensed zone provided in a range of small torque distribution amount, the correcting amount ΔI is thereafter increased suddenly with a large gradient, and then it is held in the fixed maximum value ΔIMAX. By this characteristic, a driver is prevented from receiving strange feeling caused by generation of improperly large auxiliary steering torque in the range of the small distribution amount, and a lag of leading-up of the auxiliary steering torque caused by the unsensed zone is compensated.



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CLAIMS

[Claim(s)]
[Claim 1] Driving force and braking-force-distribution equipment which distributes driving force or damping force between right-and-left rings or between order rings (T) The 1st control means (U1) which control the operation of driving force and braking-force-distribution equipment (T), and the motor which adds steering auxiliary torque to a steering system (27) It is cooperative-control equipment of the vehicles equipped with the above, and the 1st control means (U1) are characterized by driving force and the amount of braking force distributions (tangent line and TR) setting the size of an amendment signal (deltaI) as 0 in the neutral zone field below a predetermined value.
[Claim 2] The 1st control means (U1) are cooperative-control equipment of vehicles according to claim 1 characterized by an output of the amendment signal (deltaI) of a larger value than a value required to negate the torque steer phenomenon generated by the operation of driving force and braking-force-distribution equipment (T) being possible.
[Claim 3] The size of the amendment signal (deltaI) which increases according to the increase in driving force and the amount of braking force distributions (tangent line and TR) is cooperative-control equipment of vehicles according to claim 2 characterized by being held at this maximum (deltaIMAX) after reaching maximum (deltaIMAX).

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the cooperative-control equipment of the vehicles combined and equipped with the driving force and braking-force-distribution equipment which distributes driving force or damping force, and the electric power-steering equipment which adds steering auxiliary torque to a steering system between right-and-left rings or between order rings.
[0002]
[Description of the Prior Art] The technology which is made to generate the yaw moment of the revolution direction and raises turnability is well-known by making adjustable the ratio which distributes the driving force of an engine to a driving wheel on either side, and decreasing the driving force distributed to a revolution inner ring of spiral wound gasket while increasing the driving force distributed to a revolution outer ring of spiral wound gasket. In the vehicles equipped with this driving force distribution equipment, when the driving force distributed to a driving wheel on either side is changed, the problem which the control force which is not desirable generates is in the driving wheel of the right and left which serve as a steering wheel (torque steer phenomenon). then, the electric power-steering equipment with which vehicles were equipped -- using -- the electric power-steering equipment -- the above -- what is made to generate steering auxiliary torque which negates the control force which is not desirable, and mitigates a torque steer phenomenon is already proposed by these people (refer to Japanese Patent Application No. No. 302155 [nine to])
[0003]
[Problem(s) to be Solved by the Invention] By the way, although it is necessary to output a motor control signal to the control means of electric power-steering equipment without retardation [signal / amendment amendment] from the control means of driving force distribution equipment in order to mitigate exactly the torque steer phenomenon generated with the operation of driving force distribution equipment Since there is a limitation in shortening the communication period between both the aforementioned control means, delay produces the steering auxiliary torque by the amendment signal in generating, suppressing a torque steer phenomenon cannot be finished, and sense of incongruity may be given to a driver. In order to prevent this, it is possible to a value required to negate a torque steer phenomenon to set up an amendment signal more greatly. However, since the amount of driving force distribution of driving force distribution equipment is small, when a torque steer phenomenon is small and a big amendment signal is outputted by the presumed error of the amount of driving force distribution, the steering auxiliary torque which a driver does not mean occurs and sense of incongruity may be given.
[0004] It aims at preventing that big steering auxiliary torque occurs in the field where driving force and the amount of braking force distributions are small, and a driver receives sense of incongruity in the cooperative-control equipment of the vehicles which this invention was made in view of the above-mentioned situation, carries out cooperative control of driving force, braking-force-distribution equipment, and the electric power-steering equipment, and mitigate a torque steer phenomenon.
[0005]
[Means for Solving the Problem] The driving force and braking-force-distribution equipment which distributes driving force or damping force between right-and-left rings or between order rings according to invention indicated by the claim 1 in order to attain the above-mentioned purpose, The 1st control means which control the operation of driving force and braking-force-distribution equipment, and the electric power-steering equipment which has the motor which adds steering auxiliary torque to a steering system, It has the 2nd control means which compute the motor control signal which drives a motor based on the steering torque detected with the steering torque detection means at least. the 1st control means Based on the driving force and the amount of braking force distributions which driving force and braking-force-distribution equipment generate, an amendment amendment signal is [the aforementioned motor control

signal] computable. the 2nd control means It is cooperative-control equipment of the vehicles which drive a motor based on the amendment motor control signal which amended the motor control signal by the amendment signal. The cooperative-control equipment of the vehicles with which, as for the 1st control means, driving force and the amount of braking force distributions are characterized by setting the size of an amendment signal as 0 in the neutral zone field below a predetermined value is proposed.

[0006] According to the above-mentioned composition, since driving force and the amount of braking force distributions set the size of an amendment signal as 0 in the neutral zone field below a predetermined value, the 1st control means can prevent that unsuitable steering auxiliary torque occurs in the field where driving force and the amount of braking force distributions are small, and a driver receives sense of incongruity.

[0007] Moreover, according to invention indicated by the claim 2, in addition to the composition of a claim 1, the cooperative-control equipment of the vehicles characterized by an output of the amendment signal of a larger value than a value required to negate the torque steer phenomenon generated by the operation of driving force and braking-force-distribution equipment being possible for the 1st control means is proposed.

[0008] According to the above-mentioned composition, even if generating of steering auxiliary torque is overdue by having prepared the aforementioned neutral zone, by outputting the amendment signal of a larger value than a value required to negate a torque steer phenomenon, the aforementioned delay can be compensated and a torque steer phenomenon can fully be negated.

[0009] Moreover, according to invention indicated by the claim 3, in addition to the composition of a claim 2, the cooperative-control equipment of the vehicles characterized by holding it at this maximum after the size of the amendment signal which increases according to the increase in driving force and the amount of braking force distributions reaches maximum is proposed.

[0010] Since according to the above-mentioned composition the size of an amendment signal is held at this maximum after it increases according to the increase in driving force and the amount of braking force distributions and reaches maximum, it can prevent that steering auxiliary torque becomes superfluous and a driver receives sense of incongruity.

[0011]

[Embodiments of the Invention] Hereafter, it explains based on the example of this invention which showed the gestalt of operation of this invention to the accompanying drawing.

[0012] Drawing in which drawing 1 - drawing 8 show one example of this invention, and drawing 1 shows the structure of driving force distribution equipment, The block diagram in which drawing 2 shows the circuitry of the 1st electronic control unit, drawing in which drawing 3 shows the operation of driving force distribution equipment at the time of clockwise rotation in an inside low vehicle speed region, Drawing in which drawing 4 shows the operation of driving force distribution equipment at the time of anticlockwise rotation in an inside low vehicle speed region, Drawing in which drawing 5 shows the structure of electric power-steering equipment, the block diagram in which drawing 6 shows the circuitry of the 2nd electronic control unit, Drawing showing the map with which drawing 7 searches the amount of current amendments or the offset current from the amount of torque distribution, and drawing 8 are drawings showing the map with which the operation keepout area of electric power-steering equipment is searched.

[0013] As shown in drawing 1 , Transmission M is connected to the right end of the engine E carried in the body anterior part of the vehicles of a front engine front drive every width, and driving force distribution equipment T is arranged at the posterior part of these engines E and Transmission M. left drive shaft AL prolonged right and left from the left end and right end of driving force distribution equipment T And right drive shaft AR **** -- the forward left ring WFL and the forward right ring WFR are connected, respectively

[0014] Driving force distribution equipment T is equipped with the differential gear D with which driving force is transmitted from the external-tooth gear 3 which gears on the input gear 2 prepared in the input shaft 1 prolonged from Transmission M. A differential gear D consists of an epicyclic gear mechanism of a double pinion formula, and consists of planetary carriers 8 which support the inner planetary gear 7 which gears to the aforementioned external-tooth gear 3, the starter ring 4 formed in one, the sun gear 5 arranged in the interior of this starter ring 4 by the same axle, and the outer planetary gear 6 and the aforementioned sun gear 5 which get into gear to the aforementioned starter ring 4 in the state where they gear mutually. For a differential gear D, the sun gear 5 which functions as one output element while the starter ring 4 functions as an input element is left output-shaft 9L. The planetary carrier 8 which minds, and is connected to the forward left ring WFL, and functions as an output element of another side is right output-shaft 9R. It minds and connects with the forward right ring WFR.

[0015] left output-shaft 9L the carrier supported by the periphery free [rotation] -- 3 run pinion which the member 11 equips the circumferencial direction with four pinion shafts 12 arranged at intervals of 90 degrees, and formed the 1st pinion 13, the 2nd pinion 14, and the 3rd pinion 15 in one -- a member 16 is supported by each pinion shaft 12

respectively free [rotation]
[0016] Left output-shaft 9L The 1st sun gear 17 which is supported by the periphery free [rotation] and gets into gear to the 1st pinion 13 of the above is connected with the planetary carrier 8 of a differential gear D. Moreover, left output-shaft 9L The 2nd sun gear 18 fixed to the periphery gets into gear to the 2nd pinion 14 of the above. Furthermore, left output-shaft 9L The 3rd sun gear 19 supported by the periphery free [rotation] gets into gear to the 3rd pinion 15 of the above.
[0017] The number of teeth of the 1st pinion 13 in an example, the 2nd pinion 14, the 3rd pinion 15, the 1st sun gear 17, the 2nd sun gear 18, and the 3rd sun gear 19 is as follows.
[0018]
number of teeth of the 1st pinion 13 Number of teeth of the Z2 =17 2nd pinion 14 Number of teeth of the Z4 =17 3rd pinion 15 Number of teeth of the Z6 =34 1st sun gear 17 Number of teeth of the Z1 =32 2nd sun gear 18 Number of teeth of the Z3 =28 3rd sun gear 19 the Z5 =32 3rd sun gear 19 -- left hydraulic-clutch CL minding -- casing 20 -- combination -- possible -- left hydraulic-clutch CL engagement -- a carrier -- it accelerates the rotational frequency of a member 11 moreover, a carrier -- a member 11 -- right hydraulic-clutch CR minding -- casing 20 -- combination -- possible -- right hydraulic-clutch CR engagement -- a carrier -- the rotational frequency of a member 11 is slowed down And the aforementioned right hydraulic-clutch CR And left hydraulic-clutch CL The 1st electronic control unit U1 containing a microcomputer It is controlled.
[0019] it is shown in drawing 2 -- as -- the 1st electronic control unit U1 **** -- engine torque TE An engine-torque detection means S1 to detect An engine-speed detection means S2 to detect the rotational frequency Ne of Engine E A vehicle speed detection means S3 to detect the vehicle speed V Steering angle detection means S4 which detects the steering angle theta from -- a signal is inputted The 1st electronic control unit U1 Each aforementioned detection means S1 - S4 Data processing of the signal of a shell is carried out based on a predetermined program, and it is the aforementioned left hydraulic-clutch CL. And right hydraulic-clutch CR It controls.
[0020] The 1st electronic control unit U1 It has the drive shaft torque calculation means M1, the gear ratio calculation means M2, the right-and-left distribution correction-factor calculation means M3, the target yaw rate calculation means M4, the lateral acceleration calculation means M5, the right-and-left distribution correction-factor calculation means M6, the right-and-left front-wheel torque calculation means M7, and the amount calculation means M8 of current amendments.
[0021] The drive shaft torque calculation means M1 is an engine torque TE about the gear ratio nickel for which it asked from an engine speed Ne and the vehicle speed V in the gear ratio calculation means M2. By carrying out multiplication, the drive shaft torque TD (namely, total of TOKURU transmitted to the front wheels WFL and WFR on either side) is computed. In addition, engine torque TE It is possible to ask from an intake pressure (or accelerator opening) and an engine speed Ne, and it is the drive shaft torque TD. It can ask from torque detection means [which was prepared in the power transfer system besides having mentioned above], and vehicles order acceleration. Moreover, besides asking from the degree of wheel speed, the vehicle speed V may use a spatial filter, and may ask for it optically, and you may ask for it using a Doppler radar.
[0022] The right-and-left distribution correction-factor calculation means M3 is the drive shaft torque TD. It is based and is the 1st right-and-left distribution correction factor KT. While carrying out map reference, it is based on the vehicle speed V, and it is 2nd right-and-left distribution amendment ****kV. Map reference is carried out. the target yaw rate calculation means M4 -- the steering angle theta -- being based -- steering angle component Y1 of the target yaw rate Y map reference is carried out -- both -- the vehicle speed V -- being based -- vehicle speed component Y2 of the target yaw rate Y map reference -- carrying out -- these steering angle component Y1 And vehicle speed component Y2 The target yaw rate Y is computed by carrying out multiplication. By carrying out the multiplication of the vehicle speed V to the aforementioned target yaw rate Y, the lateral acceleration calculation means M5 computes lateral acceleration YG, and the right-and-left distribution correction-factor calculation means M6 is the aforementioned lateral acceleration YG. It is based and map reference of the right-and-left distribution correction factor G is carried out.
[0023] The amount tangent line of torque distribution which it ** and should be distributed to the forward left ring WFL in the right-and-left front-wheel torque calculation means M7 The amount TR of torque distribution which should be distributed to the forward right ring WFR It is computed based on the following formula.
[0024]
tangent line =(TD/2) x (1+KW xKT xKV xG) -- (1)
TR =(TD/2) x (1-KW xKT xKV xG) -- (2)
Here, they are KT and KV. The right-and-left distribution correction factor for which it asked with the right-and-left distribution correction-factor calculation means M3, and G are the right-and-left distribution correction factor for

which it asked with the right-and-left distribution correction-factor calculation means M6, and KW. It is a constant.
[0025] Moreover, (1**KW xKT xKV xG) of the right-hand side of (1) formula and (2) formulas is a term which determines the front wheel WFL on either side and the torque distribution ratio between WFR(s), and if torque distribution of one front wheels WFL and WFR increases only the specified quantity, only in the aforementioned specified quantity, torque distribution of the front wheels WFL and WFR of another side will decrease.
[0026] If the amounts tangent line and TR of torque distribution which should be distributed to the front wheels WFL and WFR on either side as mentioned above are calculated, they are the aforementioned amounts tangent line and TR of torque distribution to the front wheels WFL and WFR on either side. It is left hydraulic-clutch CL so that it may be transmitted. And right hydraulic-clutch CR It is controlled.
[0027] The amounts tangent line and TR of torque distribution distributed to the front wheels WFL and WFR of the right and left computed for the amount calculation means M8 of current amendments with the right-and-left front-wheel torque calculation means M7 It is inputted. The amount calculation means M8 of current amendments is the amounts tangent line and TR of torque distribution. It applies to the map of drawing 7 and amount of current amendments deltaI of the motor 27 of the electric power-steering equipment S mentioned later is searched. This amount of current amendments deltaI is the amounts tangent line and TR of torque distribution which driving force distribution equipment T generates. It is equivalent to the current on which electric power-steering equipment S generates the steering torque which can negate the originating torque steer phenomenon.
[0028] The dashed line in drawing 7 shows the amount of torque steers, and this amount of torque steers is the amounts tangent line and TR of torque distribution. It is proportional. amount of current amendments deltaI shown as a solid line on the other hand -- the amounts tangent line and TR of torque distribution it is not proportional -- the amounts tangent line and TR of torque distribution 0 to T1 up to -- let a field be a neutral zone -- having -- the amounts tangent line and TR of torque distribution Even if it increases, amount of current amendments deltaI is held 0. the amounts tangent line and TR of torque distribution T1 from -- T3 up to -- a field is a field which amount of current amendments deltaI increases, and sets up the inclination more greatly than the inclination of the amount of torque steers -- having -- **** -- therefore, the amounts tangent line and TR of torque distribution T2 Amount of current amendments deltaI has exceeded the amount of torque steers in the large field. and the amounts tangent line and TR of torque distribution T4 the amount of torque steers in a position sets to maximum deltaIMAX (for example, 22A) of amount of current amendments deltaI -- having -- the amounts tangent line and TR of torque distribution T3 from -- T4 up to -- a field -- amount of current amendments deltaI -- the aforementioned maximum deltaIMAX It is held.
[0029] In addition, maximum deltaIMAX of amount of current amendments deltaI Although set up by theoretical calculation and the test data, according to road surface coefficient of friction, you may change the value.
[0030] It ** and is the 1st electronic control unit U1. By instructions of a shell, it is right hydraulic-clutch CR at the time of a rectilinear-propagation run of vehicles. And left hydraulic-clutch CL It considers as both the states where it is not engaged. thereby -- a carrier -- the restraint of a member 11 and the 3rd sun gear 19 cancels -- having -- left drive shaft 9L, right drive shaft 9R, the planetary carrier 8 of a differential gear D, and a carrier -- a member 11 is altogether united and is rotated At this time, as the arrow which gave the slash to drawing 1 showed, the torque of Engine E is equally transmitted to the front wheels WFL and WFR on either side from a differential gear D.
[0031] now, at the time of clockwise rotation in an inside [of vehicles] low vehicle speed region, it is shown in drawing 3 -- as -- the 1st electronic control unit U1 from -- instructions -- right hydraulic-clutch CR being engaged -- a carrier -- a member 11 is combined with casing 20 and it is made to stop At this time, it is left output-shaft 9L of the forward left ring WFL and one. The forward right ring WFR and right output-shaft 9R (namely, planetary carrier 8 of a differential gear D) of one Since it is connected through the 2nd sun gear 18, the 2nd pinion 14, the 1st pinion 13, and the 1st sun gear 17, it is the rotational frequency NL of the forward left ring WFL. Rotational frequency NR of the forward right ring WFR It receives and accelerates due to the following formula.
[0032]
NL / NR =(Z4 / Z3) x (Z1 / Z2)
= 1.143 -- (3)
It is the rotational frequency NL of the forward left ring WFL as mentioned above. Rotational frequency NR of the forward right ring WFR It receives, and if it accelerates, as the arrow which gave the slash to drawing 3 showed, a part of torque of the forward right ring WFR which is a revolution inner ring of spiral wound gasket can be transmitted to the forward left ring WFL which is a revolution outer ring of spiral wound gasket.
[0033] in addition, a carrier -- a member 11 -- right hydraulic-clutch CR instead of making it stop -- right hydraulic-clutch CR the engagement force -- suitably -- adjusting -- a carrier, if the rotational frequency of a member 11 is slowed down It responds to the slowdown and is the rotational frequency NL of the forward left ring WFL. Rotational frequency NR of the forward right ring WFR It receives, and it can accelerate and arbitrary torque can be transmitted to

the forward left ring WFL which is a revolution outer ring of spiral wound gasket from the forward right ring WFR which is a revolution inner ring of spiral wound gasket.
[0034] On the other hand, as shown in drawing 4 at the time of anticlockwise rotation in an inside [of vehicles] low vehicle speed region, it is the 1st electronic control unit U1. It is left hydraulic-clutch CL by instructions of a shell. It is engaged and the 3rd pinion 15 is combined with casing 20 through the 3rd sun gear 19. consequently, left output-shaft 9L a rotational frequency -- receiving -- a carrier -- the rotational frequency of a member 11 accelerates -- having -- rotational frequency NR of the forward right ring WFR Rotational frequency NL of the forward left ring WFL It receives and accelerates due to the following formula.
[0035]
NR / NL = {1-(Z5 / Z6) x (Z2 / Z1)}
/ {1-(Z5 / Z6) x (Z4 / Z3)}
= 1.167 -- (4)
It is the rotational frequency NR of the forward right ring WFR as mentioned above. Rotational frequency NL of the forward left ring WFL It receives, and if it accelerates, as the arrow which gave the slash to drawing 4 showed, a part of torque of the forward left ring WFL which is a revolution inner ring of spiral wound gasket can be transmitted to the forward right ring WFR which is a revolution outer ring of spiral wound gasket. also in this case, left hydraulic-clutch CL the engagement force -- suitably -- adjusting -- a carrier -- if the rotational frequency of a member 11 is accelerated -- the accelerating -- responding -- rotational frequency NR of the forward right ring WFR Rotational frequency NL of the forward left ring WFL It receives, and it can accelerate and arbitrary torque can be transmitted to the forward right ring WFR which is a revolution outer ring of spiral wound gasket from the forward left ring WFL which is a revolution inner ring of spiral wound gasket. It is possible to **, to transmit bigger torque than a revolution inner ring of spiral wound gasket to a revolution outer ring of spiral wound gasket at the time of an inside [of vehicles] low-speed run, and to raise turnability. In addition, it is possible to lessen torque transmitted to a revolution outer ring of spiral wound gasket compared with the time of a low-speed run during the above slightly at the time of a high-speed run, or to transmit torque to a revolution inner ring of spiral wound gasket from a revolution outer ring of spiral wound gasket conversely, and to raise run stability. And they are the 1st electronic control unit U1. 2nd right-and-left distribution amendment ****kV [on the right-and-left distribution correction-factor calculation means M3 and as opposed to the vehicle speed V] It is attained by setup of a map.
[0036] (3) By having set up the number of teeth of the 1st pinion 13, the 2nd pinion 14, the 3rd pinion 15, the 1st sun gear 17, the 2nd sun gear 18, and the 3rd sun gear 19 like the above-mentioned so that clearly, when a formula and (4) formulas are compared the rate of accelerating from the forward right ring WFR to the forward left ring WFL (about 1.143), and the rate of accelerating from the forward left ring WFL to the forward right ring WFR (about 1.167) -- abbreviation -- it can be made equal
[0037] By the way, if the driving force distributed to the front wheels WFL and WFR on either side through driving force distribution equipment T changes from Engine E, the control force which is not desirable will occur according to the so-called torque steer phenomenon for the front wheels WFL and WFR of the right and left which are a steering wheel. By the vehicles equipped with electric power-steering equipment S, when a torque steer phenomenon occurs by the operation of driving force distribution equipment T, the aforementioned torque steer phenomenon can be mitigated by operating electric power-steering equipment S and generating the steering auxiliary torque of an opposite direction so that the control force by the torque steer phenomenon may be negated.
[0038] Next, the steering system of vehicles is explained based on drawing 5 .
[0039] With a driver, the steering torque inputted into the steering wheel 21 is transmitted to a rack 25 through a steering shaft 22, a connecting shaft 23, and a pinion 24, and further, reciprocation of a rack 25 is transmitted to the front wheels WFL and WFR on either side through the tie rods 26 and 26 on either side, and **** these front wheels WFL and WFR. The electric power-steering equipment S formed in the steering system is equipped with the drive gear 28 prepared in the output shaft of a motor 27, the follower gear 29 which gears on this drive gear 28, this follower gear 29, the screw shaft 30 of one, and the nut 31 connected with the aforementioned rack 25 while gearing to this screw shaft 30.
[0040] The 2nd electronic control unit U2 The operation of electric power-steering equipment S is not controlled independently, and cooperative control of the operation of electric power-steering equipment S is carried out in relation to the operation of driving force distribution equipment T.
[0041] As shown in drawing 6 , it is the 2nd electronic control unit U2. It has the target current setting means M9, the drive control means M10, the drive prohibition means M11, the drive prohibition judging means M12, the upper limit check means M13, and the subtraction means 33.
[0042] The upper limit check means M13 is the 1st electronic control unit U1. It is confirmed that amount of current

amendments deltaI by which a shell input is carried out is below 22A rightly.
[0043] The target current setting means M9 is the vehicle speed detection means S3. The vehicle speed V and the steering torque detection means S5 by which a shell input is carried out Steering torque TQ by which a shell input is carried out It is based and map reference of the target current IMS which drives the motor 27 of electric power-steering equipment S is carried out. Target current IMS is the steering torque TQ. It is set up so that it follows on increasing, and it may increase, and the vehicle speed V may follow on decreasing and may increase, and the steering auxiliary torque according to the operational status of vehicles can be generated with this property.
[0044] Amendment target current IMS' (=IMS-deltaI) is computed by the target current IMS which the target current setting means M9 outputs, and amount of current amendments deltaI which the upper limit check means M13 outputs being inputted into the subtraction means 33, and amount of current amendments deltaI being subtracted from target current IMS there. In addition, although amendment target current IMS' is computed by subtracting amount of current amendments deltaI from target current IMS when steering operation of a driver and the control force of this direction act by the operation of driving force distribution equipment T, when steering operation of a driver and the control force of an opposite direction act, amendment target current IMS' may be computed by adding amount of current amendments deltaI to target current IMS.
[0045] The drive control means M10 are the motorised signals VD about amendment target current IMS'. It changes and is the motorised signal VD. It outputs to the drive prohibition means M11. The drive prohibition means M11 is the aforementioned motorised signal VD, when a drive inhibiting signal is not inputted from the drive prohibition judging means M12. It outputs to the motor driver 32 and is the motor voltage VM. Electric power-steering equipment S is made to generate steering auxiliary torque by driving a motor 27. It can ** and assistance of steering operation of the driver which is the function of original of electric power-steering equipment S, and mitigation of a torque steer phenomenon can be made to perform simultaneously by controlling electric power-steering equipment S based on amendment target current IMS' computed from target current IMS and amount of current amendments deltaI.
[0046] When the unusual situations, such as failure of a control system, occur, a drive inhibiting signal is inputted into the drive prohibition means M11 from the drive prohibition judging means M12, and the drive prohibition means M11 is the aforementioned motorised signal VD. An output is forbidden, the operation of electric power-steering equipment S is forbidden, and electric power-steering equipment S prevents generating the steering auxiliary torque which a driver does not expect.
[0047] In the drive prohibition judging means M12, it is the current detection means S6. Motor actual current IM supplied to the detected motor 27 Steering torque detection means S5 The detected steering torque TQ and offset current deltainput output supervisor which the upper limit check means M13 outputs are inputted. In this example, offset current deltainput output supervisor is the same as amount of current amendments deltaI. The drive prohibition judging means M12 is the motor actual current IM to the map amended based on offset current deltainput output supervisor. And steering torque TQ By applying, it judges whether the drive of electric power-steering equipment S is forbidden.
[0048] Drawing 8 (A) is the conventional map for performing the above-mentioned judgment, and, originally this map is set up to the vehicles which do not perform cooperative control of the vehicles S which are not equipped with driving force distribution equipment T, i.e., electric power-steering equipment, and driving force distribution equipment T. Here, a horizontal axis is the steering torque detection means S5. Detected steering torque TQ A vertical axis is the current detection means S6. Detected motor actual current IM It expresses. Steering torque TQ on the right of the zero of a horizontal axis The field of (+) corresponds, when the steering torque of the clockwise rotation direction is inputted into a steering wheel 21, and it is the steering torque TQ on the left of the zero of a horizontal axis. The field of (-) corresponds, when the steering torque of the anticlockwise rotation direction is inputted into a steering wheel 21. Moreover, motor actual current IM above the zero of a vertical axis The field of (+) corresponds, when a motor 27 outputs the torque of the clockwise rotation direction, and it is the motor actual current IM below the zero of a vertical axis. The field of (-) corresponds, when a motor 27 outputs the torque of the anticlockwise rotation direction. And steering torque TQ And motor actual current IM When it is in the assistant keepout area which gave the slash, the drive prohibition judging means M12 outputs the instructions which forbid the drive of a motor 27 to the drive prohibition means M11.
[0049] For example, although the driver omits steering operation, it is the 2nd electronic control unit U2. Supposing it drives in the clockwise rotation direction with current with a big motor 27 by failure, it is the motor actual current IM at that time. It is set to a of the (+) field. When the motor 27 drove freely in the clockwise rotation direction, a driver is the strong steering torque TQ of the anticlockwise rotation direction to a steering wheel 21. In order to make vehicles go straight on in addition, it is the steering torque detection means S5. Steering torque TQ to detect It is set to b of the (-) field. Consequently, motor actual current IM And steering torque TQ When it goes into the assistant keepout area

which became the relation shown in drawing 8 according to P points, and gave the slash and the drive prohibition judging means M12 outputs the instructions which forbid the drive of a motor 27, it can prevent that electric power-steering equipment S generates the steering auxiliary torque which is not desirable.

[0050] Although the above explanation is applied to the vehicles which do not perform cooperative control of electric power-steering equipment S and driving force distribution equipment T, the following faults occur by the vehicles which perform cooperative control. That is, with the vehicles which perform cooperative control, it is the motor actual current IM. Since the current component for assisting steering operation of a driver and the current component for mitigating a torque steer phenomenon are contained, If the map of drawing 8 (A) which is not taking into consideration the current component for mitigating a torque steer phenomenon is used as it is An incorrect judging occurs, when electric power-steering equipment S needs to be operated, an operation may be forbidden, or an operation may be permitted when the operation of electric power-steering equipment S is unnecessary.

[0051] For example, with the vehicles which perform cooperative control, it is the steering torque TQ. A direction and the direction of the motor actual current IM may permit steering assistance also in the field (the 2nd quadrant and the 4th quadrant of drawing 8 (A)) which becomes reverse. Because, the torque steer phenomenon of the steering direction and this direction has occurred by the operation of driving force distribution equipment T, and amount of current amendments deltaI of the opposite direction for negating this torque steer phenomenon considers the case of being larger than the target current IMS of electric power-steering equipment S. Since steering assistance is forbidden, it becomes impossible in this case, to negate a torque steer phenomenon, if the map of drawing 8 (A) is used as it is.

[0052] Only the part of amount of current amendments deltaI (namely, offset current deltainput output supervisor) is making the parallel displacement of the assistant keepout area carry out in the direction of a vertical axis by this example, that this should be avoided, as shown in drawing 8 (B). Thereby, only the part of amount of current amendments deltaI makes electric power-steering equipment S generate the steering torque of the steering direction and an opposite direction, and the torque steer phenomenon accompanying the operation of driving force distribution equipment T can be negated.

[0053] now, drawing 7 explained -- as -- the amounts tangent line and TR of torque distribution 0 to T1 up to -- since a field is a neutral zone and amount of current amendments deltaI is held 0, electric power-steering equipment S does not generate the steering auxiliary torque for negating a torque steer phenomenon in this field Therefore, the amounts tangent line and TR of torque distribution They are these amounts tangent line and TR of torque distribution in a small field. Even when an error occurs in presumption, electric power-steering equipment S generating unsuitable steering auxiliary torque, and giving sense of incongruity to a driver according to the error, is prevented.

[0054] They are the amounts tangent line and TR of torque distribution as mentioned above. Although the standup of amount of current amendments deltaI will be overdue if a neutral zone is set as a small field the amounts tangent line and TR of torque distribution following it T1 to T3 The inclination of amount of current amendments deltaI is greatly set up in a field. up to -- the amounts tangent line and TR of torque distribution T2 from -- T4 up to -- by outputting amount of current amendments deltaI which exceeds the amount of torque steers in a field, the delay of the standup of the aforementioned amount of current amendments deltaI is compensated, sufficient steering auxiliary torque is generated, and a torque steer phenomenon can be mitigated certainly And the amounts tangent line and TR of torque distribution T3 Amount of current amendments deltaI is maximum deltaIMAX in a position. After reaching, it is the maximum deltaIMAX. Since it is maintained, it can prevent that electric power-steering equipment S generates superfluous steering auxiliary torque.

[0055] As mentioned above, although the example of this invention was explained in full detail, this invention can perform design changes various in the range which does not deviate from the summary.

[0056] For example, the driving force distribution equipment in this invention is not limited to what distributes driving force between right-and-left rings, but may distribute driving force between order rings. Furthermore, this invention can apply damping force also to what is distributed between right-and-left rings or between order rings.

[0057]

[Effect of the Invention] According to invention indicated by the claim 1 as mentioned above, since driving force and the amount of braking force distributions set the size of an amendment signal as 0 in the neutral zone field below a predetermined value, the 1st control means can prevent that unsuitable steering auxiliary torque occurs in the field where driving force and the amount of braking force distributions are small, and a driver receives sense of incongruity.

[0058] Moreover, according to invention indicated by the claim 2, even if generating of steering auxiliary torque is overdue by having prepared the aforementioned neutral zone, by outputting the amendment signal of a larger value than a value required to negate a torque steer phenomenon, the aforementioned delay can be compensated and a torque steer phenomenon can fully be negated.

[0059] Moreover, since according to invention indicated by the claim 3 the size of an amendment signal is held at this

maximum after it increases according to the increase in driving force and the amount of braking force distributions and reaches maximum, it can prevent that steering auxiliary torque becomes superfluous and a driver receives sense of incongruity.

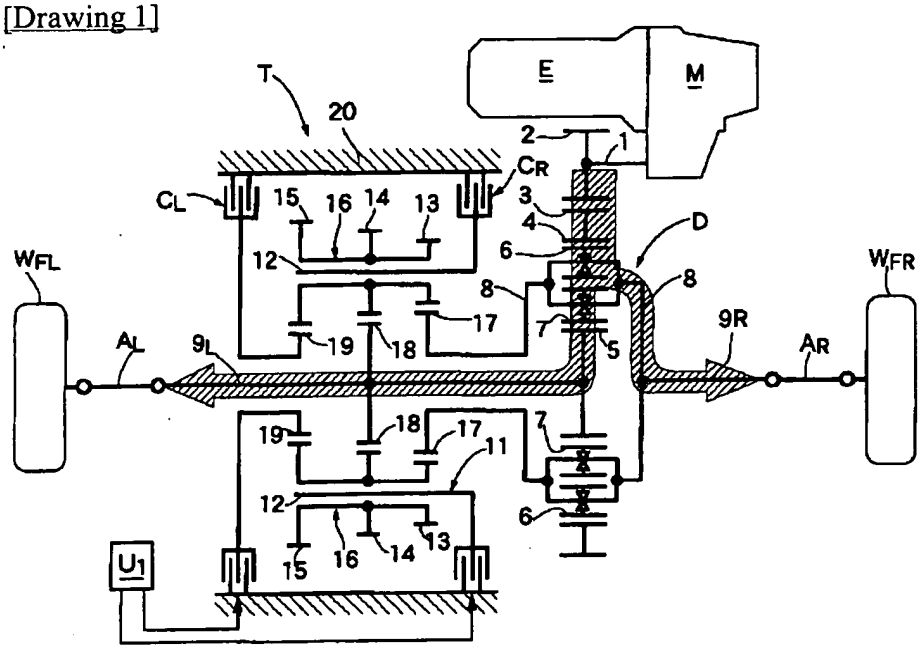
[Translation done.]

* NOTICES *

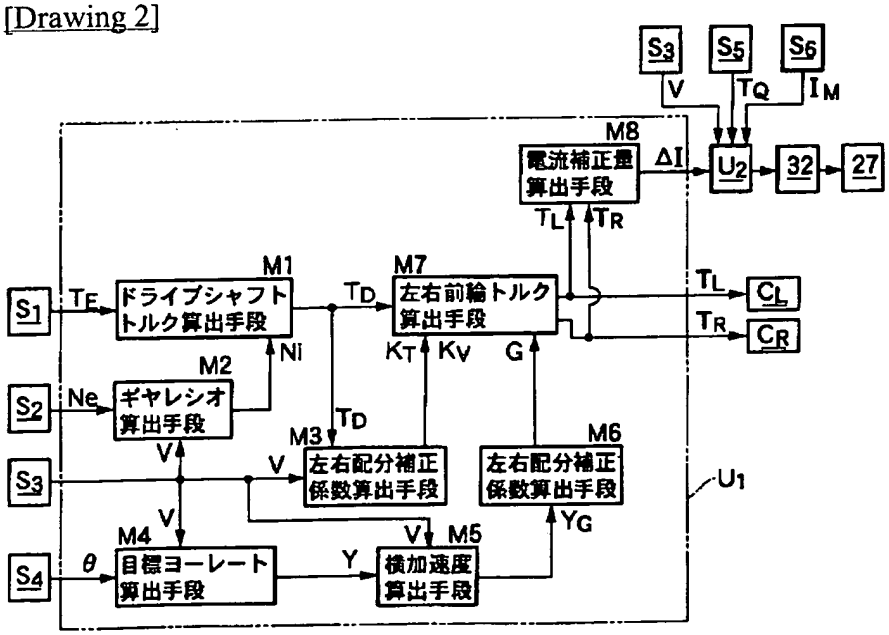
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

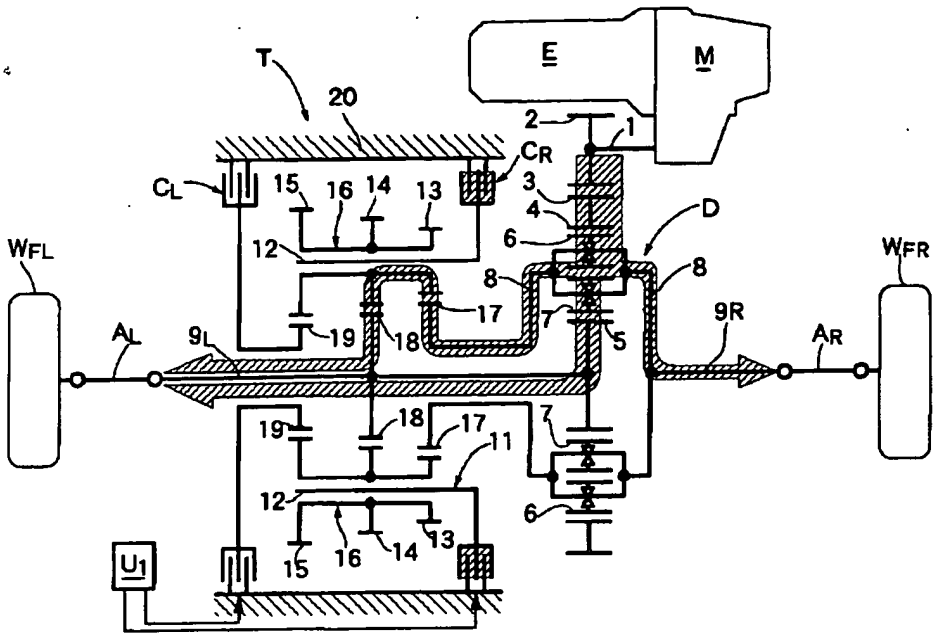
[Drawing 1]



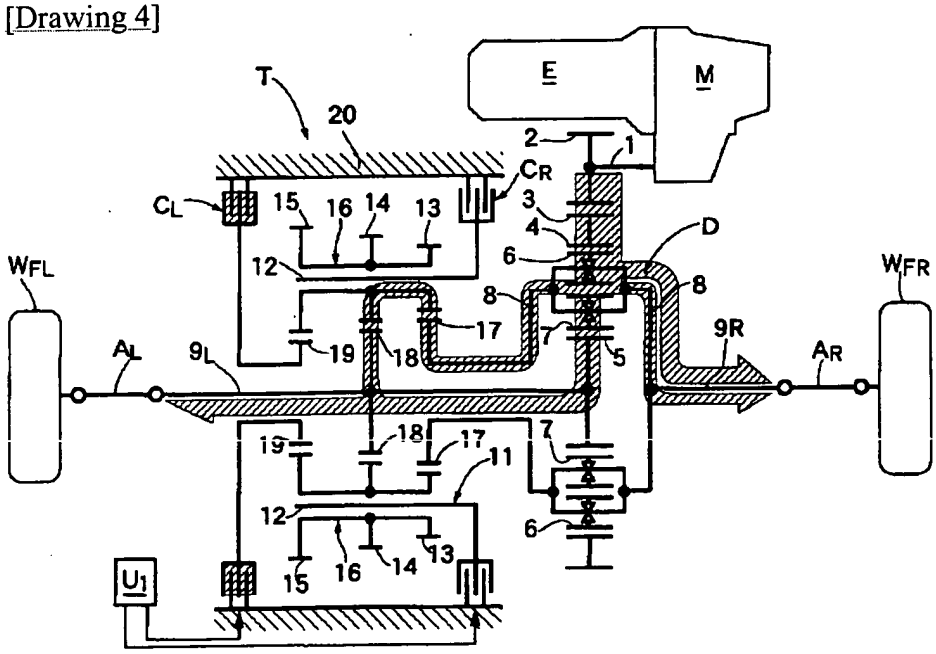
[Drawing 2]



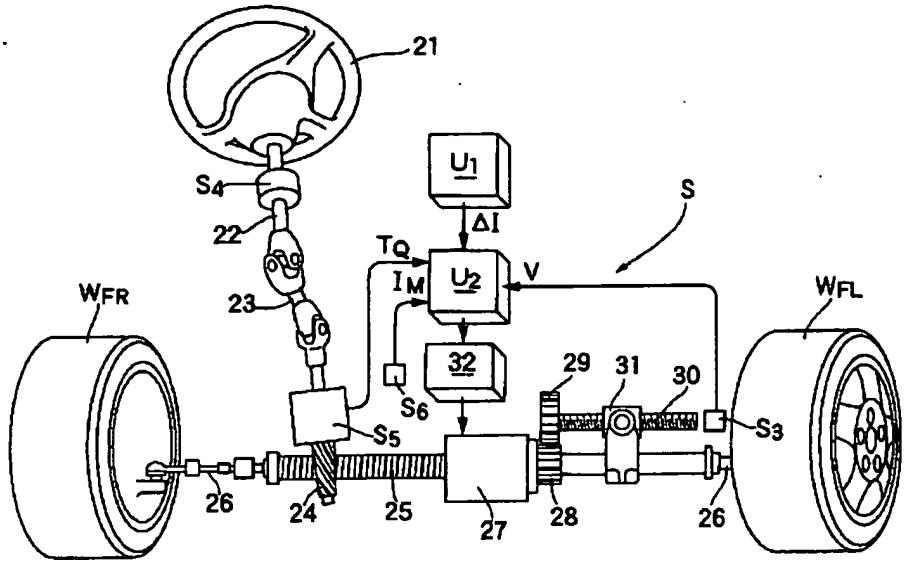
[Drawing 3]



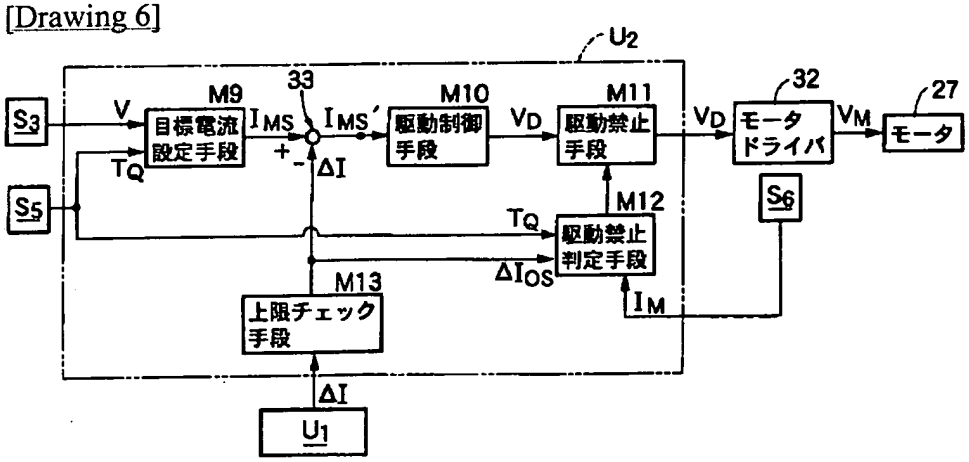
[Drawing 4]



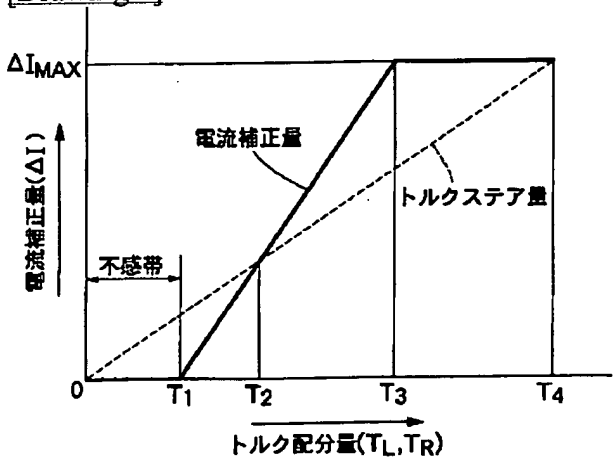
[Drawing 5]



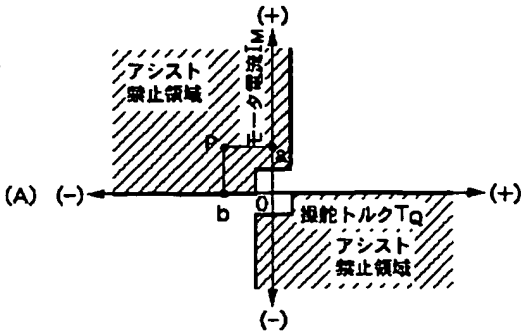
[Drawing 6]

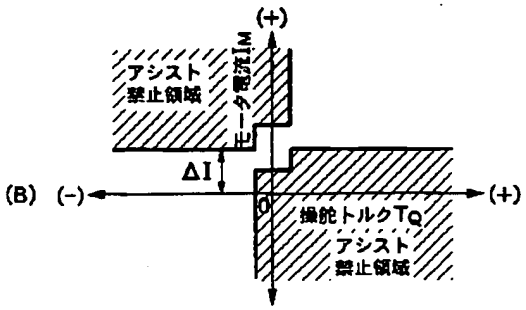


[Drawing 7]



[Drawing 8]





[Translation done.]